

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

HIDEYUKI ARAKAWA

Application No. Unassigned Art Unit: Unassigned

Filed: August 23, 2001 Examiner: Unassigned

For: SEMICONDUCTOR
DEVICE AND
MANUFACTURING
METHOD THEREOF

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D. C. 20231

Dear Sir:

Prior to the examination of the above-identified patent application, please enter the following amendments and consider the following remarks.

IN THE SPECIFICATION:

Replace the paragraph beginning at page 1, line 20, with:

When a reverse loop such as shown in Fig. 8 is utilized, an inner lead 10 and a bonding pad 6 are connected by means of a first ball 2, a bonding wire 1, and a stud bump (second ball) 9. Bonding pad 6 is formed on a semiconductor device (chip) 7 mounted on a die pad 8.

Replace the paragraph beginning at page 1, line 24 , with:

When a chip-to-chip loop such as shown in Fig. 9 is utilized, bonding pads 6 on semiconductor device 7 are connected to each other by means of first ball 2, the bonding wire 1, and stud bump (second ball) 9.

Replace the paragraph beginning at page 1, line 27 , with:

In the reverse loop or chip-to-chip technique, secondary bonding is performed on the bonding pad 6 on the chip. Here, a stud bump 9 is formed in advance on bonding pad 6 as shown in Fig. 10, and the secondary bonding is performed on stud bump 9, using a capillary 4 and a wire cut clasper 5 as shown in Fig. 11. Namely, an on-bump secondary bonding technique is used. In the on-bump secondary bonding technique, the step of arranging a stud bump is necessary, separate from the step of arranging the wire. This results in larger number of steps required for wire bonding, resulting in low efficiency in manufacturing the semiconductor devices.

Replace the paragraph beginning at page 5, line 27 , with:

Fig. 6 is a side view showing a characteristic step of manufacturing a semiconductor device in accordance with a second embodiment of the present invention.

Replace the paragraph beginning at page 6, line 4 , with:

Fig. 9 is a cross sectional view showing another example (chip-to-chip loop) of a conventional method of wire connection.

IN THE CLAIMS

Replace the indicated claims with:

1. (Amended) A semiconductor device, comprising:
 - a first conductive layer;
 - a first ball on said first conductive layer;
 - a second conductive layer spaced apart from said first conductive layer;
 - a second ball on said second conductive layer; and
 - a bonding wire connecting said first and second balls, wherein said second ball is formed by mechanically deforming said bonding wire.
2. (Amended) The semiconductor device according to claim 1, wherein said second ball is formed by bending said bonding wire on said second conductive layer.
3. (Amended) The semiconductor device according to claim 1, wherein said second ball is formed by curving said bonding wire on said second conductive layer.
5. (Amended) The semiconductor device according to claim 1, comprising
 - a base;
 - a semiconductor element on said base with a die pad interposed between said semiconductor element and said base;
 - a sealing resin sealing said semiconductor element; and
 - an external terminal on a rear surface of said base, wherein
 - said first conductive layer includes a land on said base, and
 - said second conductive layer includes a bonding pad on said semiconductor element.
6. (Amended) The semiconductor device according to claim 1, comprising:
 - a base;
 - first and second semiconductor elements mounted on said base with a die pad interposed between said base and said first and second semiconductor elements;

a sealing resin sealing said first and second semiconductor elements; and
an external terminal on a rear surface of said base, wherein
said first conductive layer includes a first bonding pad on said first
semiconductor element, and
said second conductive layer includes a second bonding pad on said second
semiconductor element.

7. (Amended) A method of manufacturing a semiconductor device, comprising,
sequentially:
joining a first ball formed at a tip end of a bonding wire to a first conductive layer;
joining said bonding wire to a second conductive layer;
mechanically deforming said bonding wire on said second conductive layer, with
said bonding wire joined to the second conductive layer; and
joining the portion of said bonding wire deformed to said second conductive layer.

8. (Amended) The method of manufacturing a semiconductor device according to
claim 7, wherein mechanically deforming said bonding wire includes bending said
bonding wire on said second conductive layer.

9. (Amended) The method of manufacturing a semiconductor device according to
claim 7, wherein mechanically deforming said bonding wire includes curving said
bonding wire on said second conductive layer.

10. (Amended) The method of manufacturing a semiconductor device according
to claim 7, wherein
said bonding wire is held by a bonding tool; and
mechanically deforming said bonding wire includes mechanically deforming said
bonding wire on said second conductive layer by moving said bonding tool with said
bonding wire being joined to said second conductive layer.

IN THE ABSTRACT

Replace the abstract with:

ABSTRACT OF THE DISCLOSURE

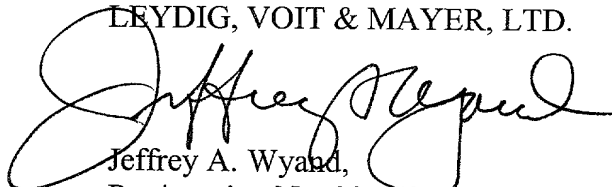
A semiconductor device includes an inner lead, a first ball on the inner lead, a bonding pad on the semiconductor device, a second ball on the bonding pad, and a bonding wire connecting the first and second balls. The second ball is formed by mechanically deforming the bonding wire.

REMARKS

The foregoing amendments are made to correct minor translational errors and to meet United States requirements as to form. No new matter is added.

Respectfully submitted,

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For:	SEMICONDUCTOR DEVICE AND MANUFACTURING METHOD THEREOF		

**AMENDMENTS TO SPECIFICATION, CLAIMS, AND
ABSTRACT MADE VIA PRELIMINARY AMENDMENT**

Amendments to the paragraph beginning at page 1, line 20:

When a reverse loop such as shown in Fig. 8 is utilized, an inner lead 10 and a bonding pad 6 are connected by means of a first ball 2, a bonding wire 1, and a stud bump (second ball) 9. Bonding pad 6 is formed on a semiconductor device (chip) 7 mounted on a die pad 8.

Amendments to the paragraph beginning at page 1, line 24:

When a chip-to-chip loop such as shown in Fig. 9 is utilized, bonding pads 6 ~~formed~~ on semiconductor device 7 are connected to each other by means of first ball 2, the bonding wire 1, and stud bump (second ball) 9.

Amendments to the paragraph beginning at page 1, line 27:

In the reverse loop or chip-to-chip technique, secondary bonding is performed on the bonding pad 6 on the chip. Here, a stud ~~bumps~~ bump 9 is formed in advance on bonding pad 6 as shown in Fig. 10, and the secondary bonding is performed on stud bump 9, using a capillary 4 and a wire cut clasper 5 as shown in Fig. 11. Namely, an on-bump

secondary bonding technique is used. In the on-bump secondary bonding technique, the step of arranging a stud bump is necessary, separate from the step of arranging the wire. This results in larger number of steps required for wire bonding, resulting in low efficiency in manufacturing the semiconductor devices.

Amendments to the paragraph beginning at page 5, line 27:

Fig. 6 is a side view showing a characteristic step of manufacturing ~~the~~ a semiconductor device in accordance with a second embodiment of the present invention.

Amendments to the paragraph beginning at page 6, line 4:

Fig. 9 is a cross sectional view showing another example (chip-to-chip loop) of ~~the~~ a conventional method of wire connection.

Amendments to the existing claims:

1. (Amended) A semiconductor device, comprising:
a first conductive layer;
a first ball ~~formed~~ on said first conductive layer;
a second conductive layer ~~arranged~~ spaced apart from said first conductive layer;
a second ball ~~formed~~ on said second conductive layer; and
a bonding wire connecting said first and second balls, wherein said second ball is formed by mechanically deforming said bonding wire.
2. (Amended) The semiconductor device according to claim 1, wherein said second ball is formed by bending said bonding wire on said second conductive layer.
3. (Amended) The semiconductor device according to claim 1, wherein said second ball is formed by ~~making~~ curving said bonding wire ~~curved~~ on said second conductive layer.

5. (Amended) The semiconductor device according to claim 1, comprising
a base;
a semiconductor element ~~formed~~ on said base with a die pad interposed between
said semiconductor element and said base;
a sealing resin sealing said semiconductor element; and
an external terminal ~~formed~~ on a rear surface of said base, wherein
said first conductive layer includes a land ~~formed~~ on said base, and
said second conductive layer includes a bonding pad ~~formed~~ on said
semiconductor element.
6. (Amended) The semiconductor device according to claim 1, comprising:
a base;
first and second semiconductor elements mounted on said base with a die pad
interposed between said base and said first and second semiconductor elements;
a sealing resin sealing said first and second semiconductor elements; and
an external terminal ~~formed~~ on a rear surface of said base, wherein
said first conductive layer includes a first bonding pad ~~formed~~ on said first
semiconductor element, and
said second conductive layer includes a second bonding pad ~~formed~~ on said
second semiconductor element.
7. (Amended) A method of manufacturing a semiconductor device, comprising,
sequentially:
~~a first bonding step of~~ joining a first ball formed at a tip end of a bonding wire to a
first conductive layer;
~~after said first bonding step,~~ joining said bonding wire to a second conductive
layer;
mechanically deforming said bonding wire on said second conductive layer, with
said bonding wire joined to the second conductive layer; and
~~a second bonding step of~~ joining the ~~deformed~~ portion of said bonding wire
deformed to said second conductive layer.

8. (Amended) The method of manufacturing a semiconductor device according to claim 7, wherein ~~said step of mechanically deforming said bonding wire includes the step of bending said bonding wire on said second conductive layer.~~

9. (Amended) The method of manufacturing a semiconductor device according to claim 7, wherein ~~said step of mechanically deforming said bonding wire includes the step of making curving said bonding wire curved on said second conductive layer.~~

10. (Amended) The method of manufacturing a semiconductor device according to claim 7, wherein

said bonding wire is held by a bonding tool; and

~~said step of mechanically deforming said bonding wire includes the step of~~
mechanically deforming said bonding wire on said second conductive layer by moving said bonding tool with said bonding wire being joined to said second conductive layer.

Amendments to the abstract:

ABSTRACT OF THE DISCLOSURE

A semiconductor device ~~of the present invention~~ includes an inner lead, a first ball ~~formed~~ on the inner lead, a bonding pad ~~formed on a the~~ semiconductor device, a second ball ~~formed~~ on the bonding pad, and a bonding wire connecting the first and second balls. The second ball is formed by mechanically deforming the bonding wire.

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For: SEMICONDUCTOR
DEVICE AND
MANUFACTURING
METHOD THEREOF

PENDING CLAIMS AFTER ENTRY OF PRELIMINARY AMENDMENT

1. A semiconductor device, comprising:
a first conductive layer;
a first ball on said first conductive layer;
a second conductive layer spaced apart from said first conductive layer;
a second ball on said second conductive layer; and
a bonding wire connecting said first and second balls, wherein said second ball is formed by mechanically deforming said bonding wire.
2. The semiconductor device according to claim 1, wherein said second ball is formed by bending said bonding wire on said second conductive layer.
3. The semiconductor device according to claim 1, wherein said second ball is formed by curving said bonding wire on said second conductive layer.
4. The semiconductor device according to claim 1, wherein
said first conductive layer includes an inner lead; and
said second conductive layer includes a bonding pad.

5. The semiconductor device according to claim 1, comprising
a base;
a semiconductor element on said base with a die pad interposed between said semiconductor element and said base;
a sealing resin sealing said semiconductor element; and
an external terminal on a rear surface of said base, wherein
said first conductive layer includes a land on said base, and
said second conductive layer includes a bonding pad on said semiconductor element.

6. The semiconductor device according to claim 1, comprising:
a base;
first and second semiconductor elements mounted on said base with a die pad interposed between said base and said first and second semiconductor elements;
a sealing resin sealing said first and second semiconductor elements; and
an external terminal on a rear surface of said base, wherein
said first conductive layer includes a first bonding pad on said first semiconductor element, and
said second conductive layer includes a second bonding pad on said second semiconductor element.

7. A method of manufacturing a semiconductor device, comprising, sequentially:
joining a first ball formed at a tip end of a bonding wire to a first conductive layer;
joining said bonding wire to a second conductive layer;
mechanically deforming said bonding wire on said second conductive layer, with said bonding wire joined to the second conductive layer; and
joining the portion of said bonding wire deformed to said second conductive layer.

8. The method of manufacturing a semiconductor device according to claim 7, wherein mechanically deforming said bonding wire includes bending said bonding wire on said second conductive layer.

9. The method of manufacturing a semiconductor device according to claim 7, wherein mechanically deforming said bonding wire includes curving said bonding wire on said second conductive layer.

10. The method of manufacturing a semiconductor device according to claim 7, wherein

said bonding wire is held by a bonding tool; and

mechanically deforming said bonding wire includes mechanically deforming said bonding wire on said second conductive layer by moving said bonding tool with said bonding wire being joined to said second con